National Aeronautics and Space Administration

NASA Gulf of Mexico Initiative Hypoxia Research

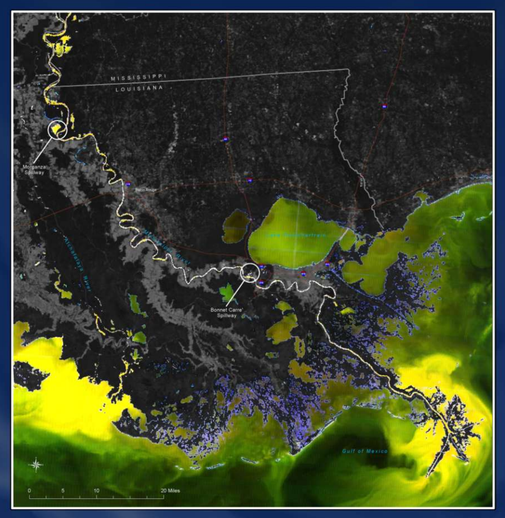
The Applied Science & Technology Project Office at Stennis Space Center (SSC) manages NASA's Gulf of Mexico Initiative (GOMI). Addressing short-term crises and long-term issues, GOMI participants seek to understand the environment using remote sensing, *in-situ* observations, laboratory analyses, field observations and computational models. New capabilities are transferred to end-users to help them make informed decisions. Some GOMI activities of interest to the hypoxia research community are highlighted below.

Project Title: Monitoring the Mississippi River Plume from the Opening of the Bonnet Carré Spillway

Principal Investigator: Bill Graham, NASA Stennis Space Center

In the spring of 2011, there was tremendous flooding along the Mississippi River. To save Baton Rouge and New Orleans, the US Army Corps of Engineers opened the Morganza and Bonnet Carré spillways in May 2011, allowing floodwaters to flow into Lake Pontchartrain and the Atchafalaya River basin. Supporting the United States Geological Survey National Wetland Research Center flood response, NASA scientists at Stennis Space Center used data from the MODIS, ASTER, ALI and Landsat instruments flying on four satellites to generate flood maps. The maps were used to study the extent of the flooding and to monitor the influx of nutrient-rich fresh water into the coastal lakes, the Mississippi Sound and the Louisiana shelf.

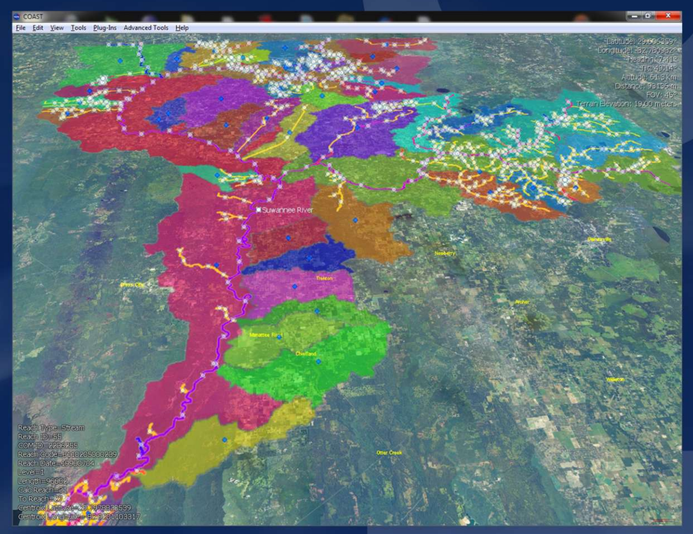
In this image, sediment in the floodwater is yellow. Daily updates from some sensors enabled NASA and USGS scientists to monitor flooding on a regional scale and quickly detect local features such as the flow of fresh water from Lake Pontchartrain into Lake Borgne.

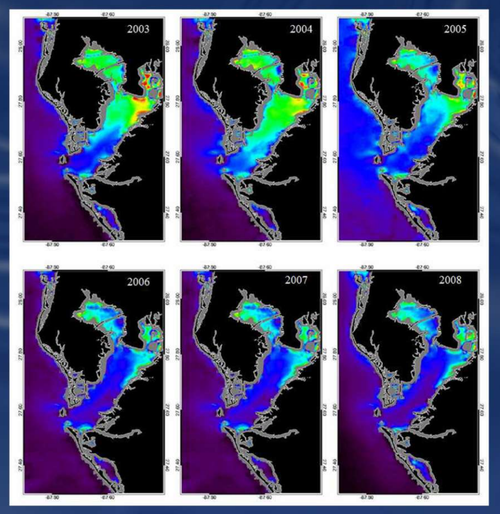


Project Title: Enhancing NASA's COAST Online Application for Agricultural Best Management Practices Decision Support

Principal Investigator: Katherine Milla, Florida A&M University

The lower Suwannee River basin in central Florida has been subjected to increased use of pesticides and fertilizers, runoff from dairy and poultry farms, and contaminants from pulp mills and phosphate mines. The Florida Department of Agriculture and Consumer Services (FDACS) Office of Agricultural Water Policy implements agricultural best management practices (BMPs) which can reduce inputs of agricultural nutrients to surface waters that empty into the Gulf of Mexico. Because adoption of BMPs is voluntary, it is crucial that FDACS personnel have tools that can effectively communicate the benefits of nutrient management and can assist in selecting the BMPs for specific sites. This project integrated NASA's Coastal On-line Assessment and Synthesis Tool (COAST) and a sophisticated hydrological model provided by Soil Water Engineering Technology, Inc. The resulting 3D virtual globe presents information in a way familiar to land owners, enables FDACS personnel to capture site data and initiate simulations that identify BMPs for that site. The results of this proposal can be adapted for different geographic regions that contribute nutrient inputs to the Gulf of Mexico to help reduce the overall nutrient inputs to the Gulf.

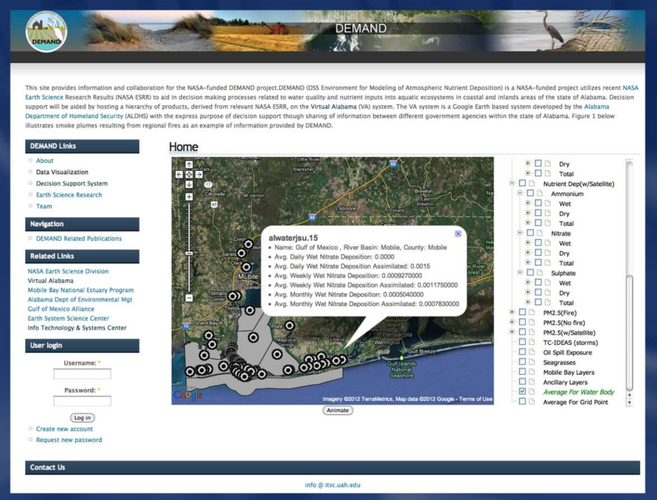




Project Title: Enhancing Estuarine Water Quality Management Through Integrating Earth Science Research Results: A Targeted Project for Tampa Bay, Florida.

Prime Investigator: Chuanmin Hu, University of South Florida

Presently, monitoring of estuarine water quality in the Gulf of Mexico is largely based on *in-situ* surveys. These costly and labor intensive efforts may be inadequate to fully characterize short-term status and long-term trends, and thus could lead to biased statistics and decisions. Tampa Bay estuary has been monitored for several decades using boat surveys, which provided a unique dataset to test our remote sensing approaches to water quality monitoring and management. The first objective was to improve an existing water quality decision matrix (WQDM) through use of the latest high spatiotemporal satellite (MODIS and others) observations of Tampa Bay, Florida's largest open-water estuary. The second objective was to expand such remote sensing capacity to other estuaries and to work with the Gulf of Mexico Alliance's Water Quality and Nutrient Reduction Priority Information Teams, as well as other research groups, to establish a concerted and consistent plan for Gulf of Mexico estuaries. The series of images to the right show annual mean chlorophyll-a concentrations derived from MODIS. The decreasing trend from 2003-2004 to 2006-2008 is primarily driven by climate variability (precipitation).



Project Title: DEMAND - DSS Environment for Modeling of Atmospheric Nutrient Deposition

Principal Investigator: Udaysankar Nair, University of Alabama, Huntsville

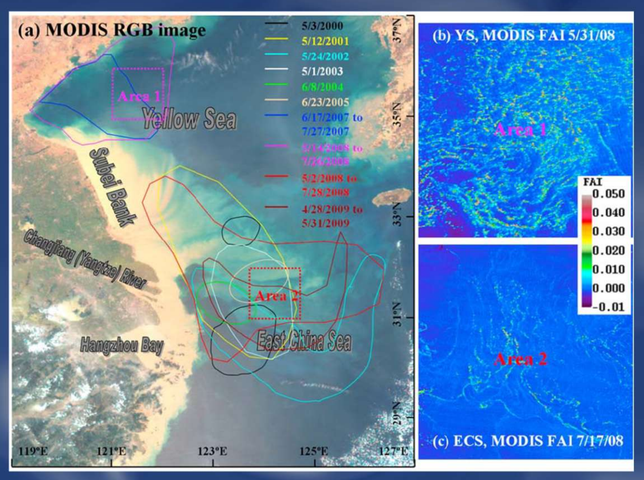
Atmospheric nutrient deposition plays a role in the formation of hypoxic zones in the Gulf of Mexico. MODIS data coupled with output from the chemical/aerosol transport model (CMAQ/AERO-RAMS) are used to estimate wet and dry deposition of nutrients (N, S, Fe and P) over land, inland water bodies, estuaries and the Gulf of Mexico region. Output from the model is used to partition observed aerosol column loading into different categories and deposition potentials are computed. DEMAND supports decision making processes related to water quality and nutrient inputs into aquatic ecosystems in coastal and inlands areas in the state of Alabama. Results are hosted on the Virtual Alabama (VA) system. VA is a Google Earth based system developed by the Alabama Department of Homeland Security with the express purpose of sharing of information between different government agencies within the state of Alabama. End users include the Alabama Department of Environmental Management and the Mobile Bay National Estuary Program.

Project Title: On the recurrent *Ulva prolifera* blooms in the Yellow Sea and East China Sea

Prime Investigator: Chuanmin Hu, University of South Florida

Capabilities developed by GOMI researchers in the Gulf of Mexico are also applicable in other parts of the world.

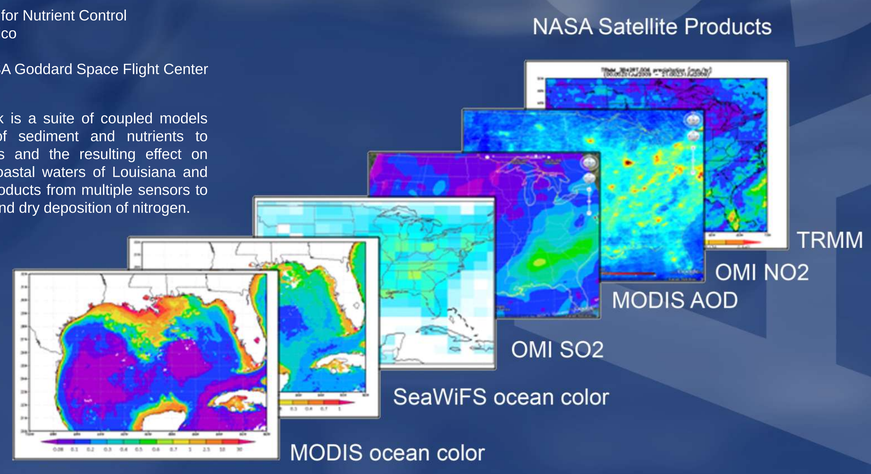
Approximate location and distribution of *U. prolifera* identified from MODIS imagery between April 2000 and May 2009. The background MODIS RGB image on 5 April 2003 shows the extensive sediment plume from the Subei Shallow Bank to the East China Sea (ECS). Nearly all *U. prolifera* algae slicks in the ECS were found in the downstream portion of this plume, which occurs every year between fall and spring following cross-shelf currents between the Subei Bank and the ECS [Yuan et al., 2008]. (b and c) MODIS images tracing *U. prolifera* blooms in 1 × 1° areas in the Yellow Sea and ECS on 31 May 2008 and 17 July 2008, respectively.



Project Title: Improved Hypoxia Modeling for Nutrient Control Decisions in the Gulf of Mexico

Principal Investigator: Shahid Habib, NASA Goddard Space Flight Center

The Gulf of Mexico Modeling Framework is a suite of coupled models linking the deposition and transport of sediment and nutrients to subsequent bio-geo chemical processes and the resulting effect on concentrations of dissolved oxygen in coastal waters of Louisiana and Texas. This project utilizes NASA data products from multiple sensors to attempt to improve the estimation of wet and dry deposition of nitrogen.



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